Chapter 4
OUTLET STRUCTURES

Description

Outlet structures are used to reduce and/or control energy from ditch or culvert discharge, and release the discharge downstream under controlled, stable conditions.

Importance to Maintenance & Water Quality

Outlet structures reduce the velocity of water carried by road ditches and culverts, therefore helping to control sedimentation. Water should outlet to areas with moderate slopes and vegetative filter strips or riparian areas before entering surface waters. This type of outlet, often referred to as day-lighting, will allow for most of the sediments and other pollutants to be removed before runoff enters surface waters.

Location

Outlet structures should be located where concentrated, turbulent, and/or high velocity flows are discharged onto areas which can be erosive, or where the discharged water requires filtration or settling of sediments. This can be outlets for swales and road ditches, flumes, runoff management culverts within the road ditch system, or culverts used at stream crossings.

Implementation

Structures

Splash/Stilling/Plunge Basin

Basins (usually rock- lined) which are water-filled, or will fill with water during runoff events, located at high-energy outlets of conveyance structures such as steep flumes, and more usually, cantilevered pipe outlets.

The purpose is to use the pooled water to dissipate the energy of the flowing water discharged by the conveyance structure. Basins are usually constructed as a depression below the outlet channel elevation as shown in figure 4-1, but can be constructed with the basin bottom at the outlet channel elevation and the basin formed by constructing a weir (riprap, gabion, etc.) across the outlet channel as shown in figure 4-2. The basin is usually wider than the outlet channel by

design and tapers to fit the existing channel at the basin exit point. The basins must always be lined with a properly sized and/or classified, non-erosive lining such as riprap, concrete mats, gabions, etc. underlain with filter fabric or a graded aggregate filter. These structures require the design services of a professional engineer.

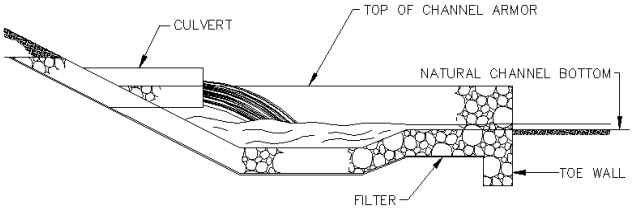

Figure 4-1. Depressed Type Plunge Basin Illustration

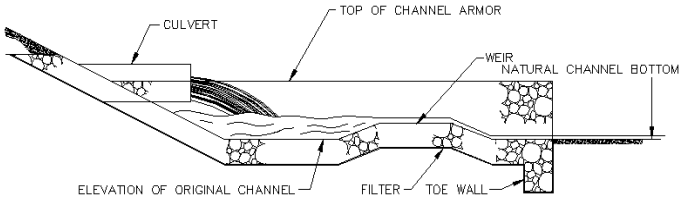

Figure 4-2. Weir-formed Plunge Basin Illustration

Splash Apron

A widened, flat, armored area, level to slightly sloping, located at the low-energy discharge point of conveyance structures and/or splash/plunge basins. Flow exiting this structure should enter a stream or vegetated outlet.

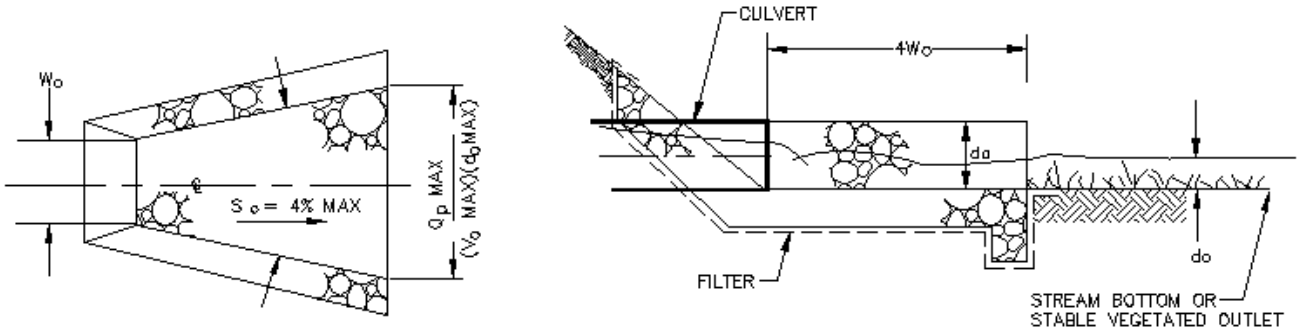

Figure 4-3. Splash Apron Illustration

As shown in figure 4-3, the structure's bottom dimensions taper from a narrow width at the conveyance structure discharge point to a wider dimension at the outlet some distance downstream. This spreads the water in a fanning action over the rough, armored surface reducing the velocity, and promoting sheet flow as the water exits into streams or onto vegetated

Exhibit 4.1a - Depressed-type energy dissipating basin at culvert discharge with transition apron to outlet channel.

Exhibit 4.1b - Depressed-type plunge basin at culvert discharge with transition apron to outlet channel.

Exhibit 4.1c - Weir-formed plunge basin at culvert discharge with transition apron to narrow outlet channel.

Exhibit 4.1 - Splash/Stilling/Plunge Basins

Exhibit 4.2 - Drop Inlet/Box/Manhole

Exhibit 4.3 - Stilling Well

areas. Armored side slopes are often necessary to prevent scour and erosion along the edge of the structure. The armor usually extends above and around pipe structures and blends into other conveyance structures to prevent scour and undermining at the discharge point. Toe walls may also be necessary where the structure outlets onto earthen surfaces. Armor material should be sized and/or classified to withstand the maximum design discharge velocities.

Drop Inlet/Box/Manhole

An enclosed structure, constructed or prefabricated from reinforced concrete, concrete blocks, bricks, plastic, or other sound structural material, which will receive the discharge end of a culvert, flume, ditch, etc., dissipate the energy, and safely release the discharged runoff at a lower elevation. See figure 4-4 below.

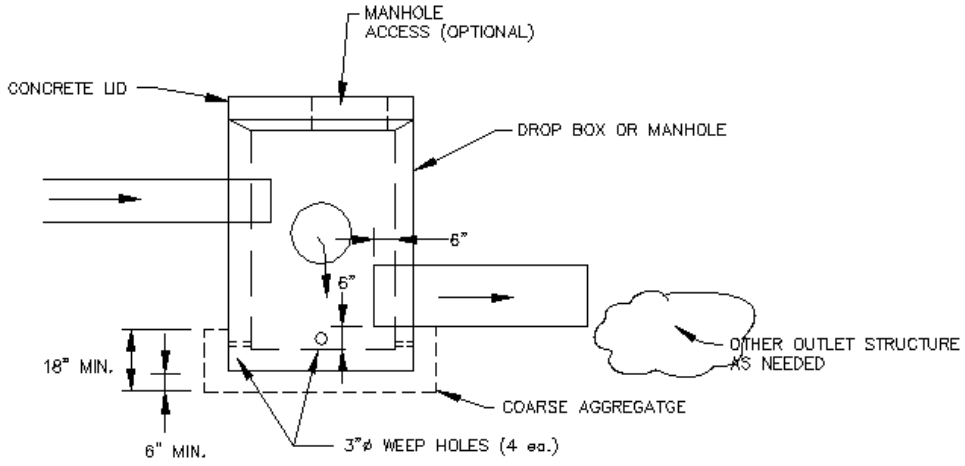

Figure 4-4. Drop Inlet/Box/Manhole Illustration

This structure works well where there is a severe cross-slope from one side of the road to the other and a cross-drain culvert is installed, or where there is a desire to reduce road ditch and flume slopes. This situation is often found where head cutting gullies have eroded up to the roadway. These structures require the design of a professional engineer.

Stilling Well

An enclosed structure, constructed or prefabricated from reinforced concrete, concrete blocks, bricks, plastic, or other sound structural material, which will receive the discharge end of a culvert or pipe, dissipate the energy, and safely release the discharged runoff at a higher level.

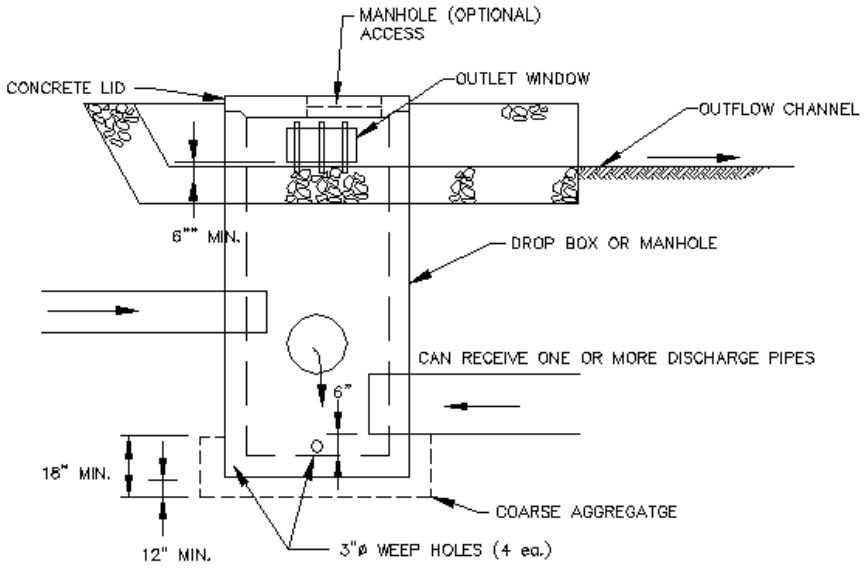

Figure 4-5. Stilling Well Illustration

a. To be used only at the singular outlet location of one or more pipes.

b. Use only when lowest pipe *inlet* invert will be higher than the outlet invert of the stilling well structure.

c. This structure works well in areas where energy dissipating structures are needed at the ends of pipes and there is limited space to install such structures. Also can be a cost-saving structure.

d. These structures require the design of a professional engineer.